CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Leachate is the liquid that drains or pass through a landfill that is usually contains both dissolved and suspended materials. Leachate generations nowadays has become a major problem for municipal solid waste (MSW) landfills and also affected surface and ground water (Raghab et al., 2013). The natural characteristic of leachate that contains nitrogen, phosphorus, potassium and trace elements has been a potential and a viable way to generate new economic sources. The term 'vermicomposting' is basically refers to the use of earthworms for composting organic matter in developing organic fertilizer. Vermicomposting process can help in eliminating pathogens, parasites and weed seeds content in the leachate as well as improving soil structure (Chowdhury et al., 2014). Other than that, it can help in reducing substrate odors while increasing the content of available form of macronutrients. Production of high quality vermicompost requires optimal conditions for the survival and development of earthworms. Several parameters such as pH, C/N ratio, temperature and moisture content need to be considered in preparing an optimum condition of the vermicompost. Humidity is an important factor for the activity of earthworms. It is recommended that the moisture content of the compost should be in a range of 50-70%, while the optimum temperature for earthworms range from 12 to 28^{o}C (Bożym & Engineering, 2016). Since the leachate contains high amount of nitrogen, so rice husk, which is a good bulking agent will be used as the additive in the composting process as it rich in organic carbon that is needed to stabilize the carbon to nitrogen (C/N) ratio of the compost. The good compost required a C/N ratio between 25:1 to 30:1 to be used as a soil amendment (USDA-NRCS, 2011). The composted leachate is the source of organic matter with a unique ability to improve the chemical, physical and biological characteristics of soils (Romero et al., 2013). Nowadays, the demand on bio-fertilizer has increasing rapidly. Global bio-fertilizers market size was estimated at USD 535.8 million in 2014 (Agrochemical and

Fertilizers, 2016). Growing awareness about product benefits is expected to augment demand over the forecast period. Figure 1.1 shows the increasing market revenue of bio-fertilizer over 10 years forecast period.

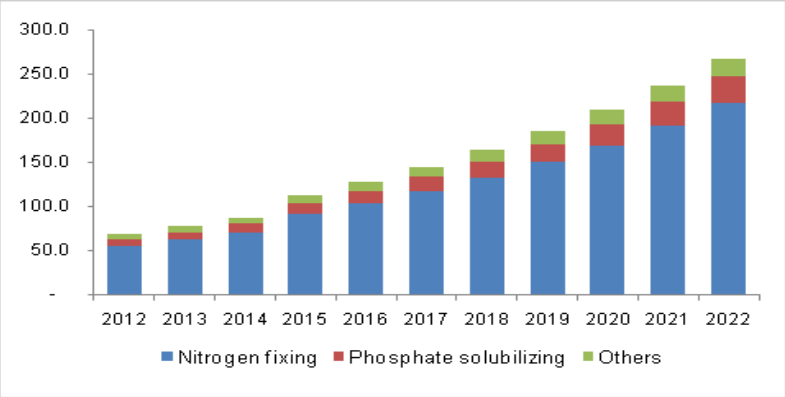

Figure 1.1: U.S. bio-fertilizers market revenue by product (USD Million), 2012-2022 (Market & Analysis, 2017)

Thus, a study will be conducted to identify the amount of Nitrogen-N, Phosphorus-P, and Potassium-K, (NPK) composition in the composted materials (leachate + soil + rice husk) throughout the composting process. These NPK are numerous building biological that plants need for a healthy growth. Thus, the NPK content could be utilized to produce high and better quality of bio-fertilizer by composting the materials in the right ratio and keeping them in the optimum condition. This research focus on controlling the NPK and its processing parameters that affecting the value of NPK particularly. The basic parameters of the leachate like biochemical oxygen demand (BOD), chemical oxygen demand (COD), pH and total suspended solid (TSS) will be tested first. Next, it will be composted with soil and rice husk in three different mass ratios. The samples will undergo the NPK analysis by using HACH Spectrophotometer throughout the vermicomposting process which takes four weeks to finish. The outcome of this research is to produce value added end-product (i.e: the bio-fertilizer), which has significance effect on the growth and yield of the plants.

1.2 Motivation

Excessive reliance on chemical fertilizers has led to the exhaustion of soil of its nutrients reserves. Thus, bio-fertilizer serves as an alternative way to deal with this issue as to maintain a long term soil fertility and sustainability. Heavy use of chemical fertilizers has also led to the environmental pollution and contamination of soil, has polluted water basin and making the crop more prone to diseases. Other than that, massive waste generation is attracting much global attention in recent time due to increasing population, changing consumption patterns, urbanization and industrialization. Landfilling is the most common method in dealing with municipal solid wastes worldwide, and leachate produced from landfills as a result of water percolating through or emerging from the buried waste is a major environmental concern. Harmful leachate generated from landfill in high amount, which is 3 million litre per day in Malaysia (Alaribe & Agamuthu, 2010), nowadays are released into underground water stream and has contaminated the soil.

In 2008, about 620 million tons of rice straw and 125 million tons of rice husks, referred to as residues were produced in Asia, and this quantity is increasing every year. These residues have no commercial values in most places and have been disposed of in various ways. Burning of rice husk residues is a popular disposable practice and has caused severe air pollution in some regions (Pode, 2016). Alternatively, the residue has been incorporated into the soil, but in turn it has led to methane emissions from rice fields and thus contributing to climate change. Thus, there is an urgent need to find ways and means to alleviate these problems.

1.3 Problem Statement

Leachate in the landfill have a good potential to be used as an organic fertilizer as it contain carbon, nitrogen, phosphorus, potassium and trace elements that can be used as nutrients by plants (Romero et al., 2013). Finding a way to properly dispose leachate in the landfill without contaminating the water and soil are major concern of waste management. There are numerous studies before investigated the potential of sewage sludge to be develop as a bio-